

Nov. 28, 1944.

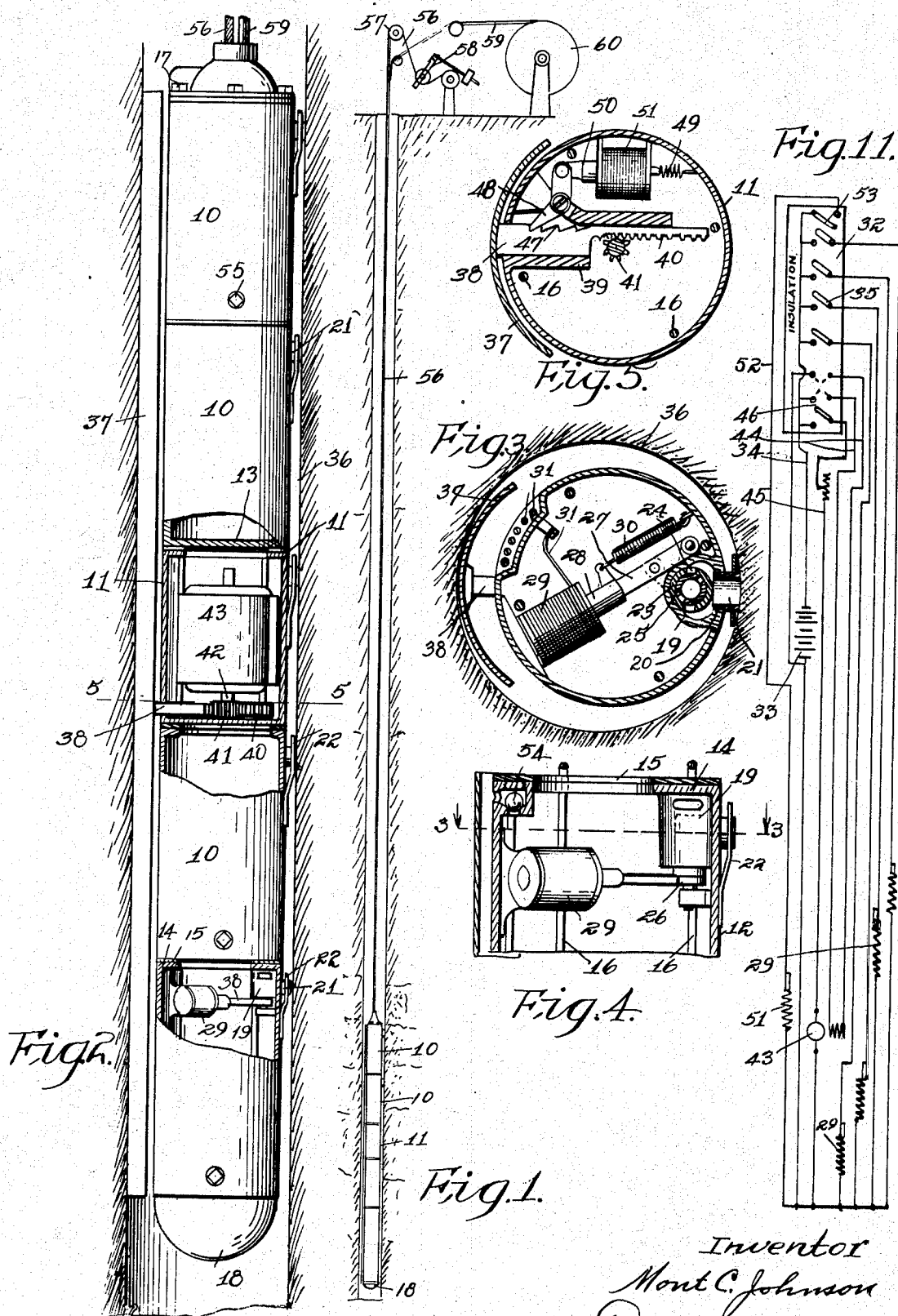
M. C. JOHNSON

2,363,793

WELL TESTING APPARATUS

Filed July 14, 1941

2 Sheets-Sheet 1



Inventor
Mont C. Johnson
by *Dring & Hagler*
Att'ys

Nov. 28, 1944.

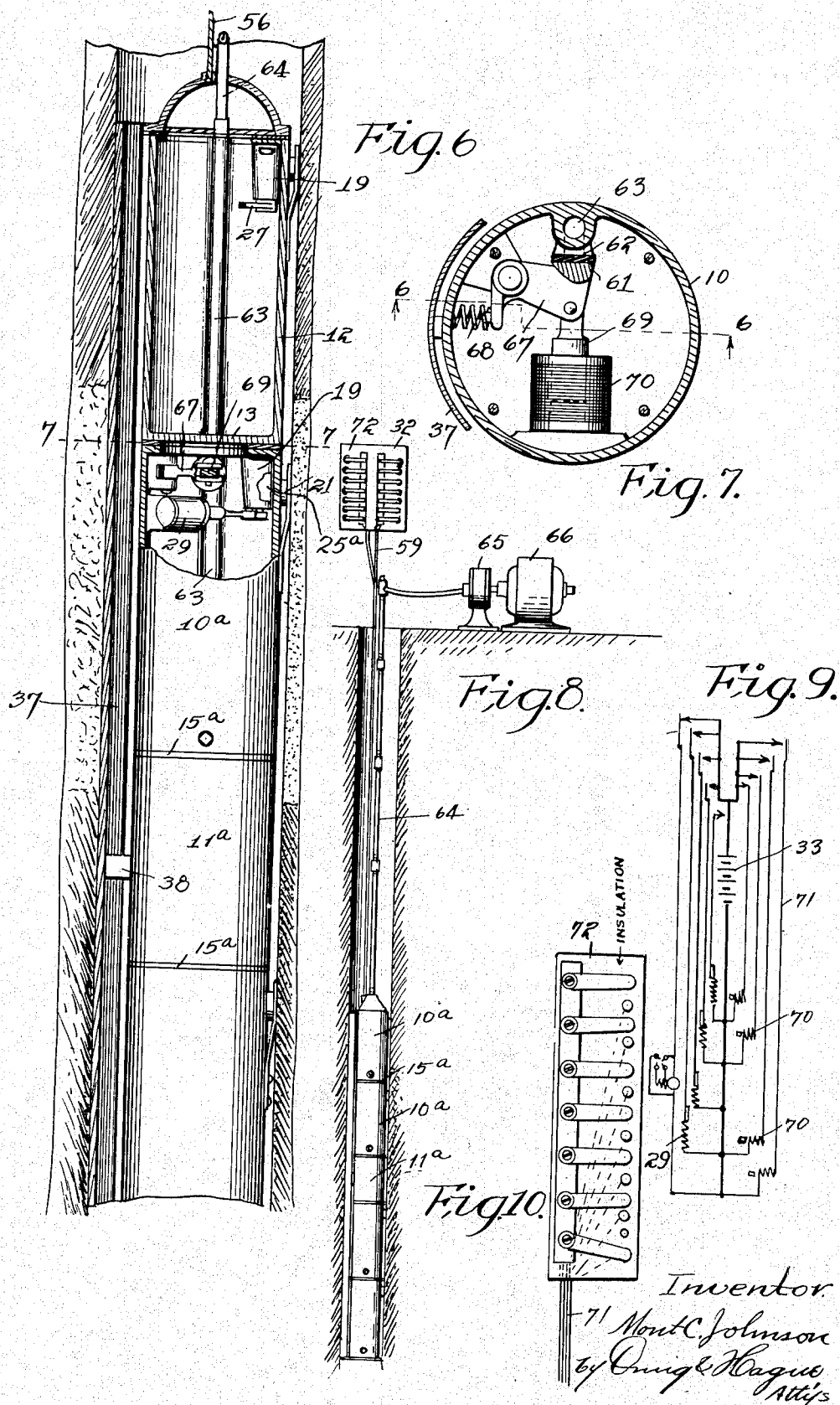
M. C. JOHNSON

2,363,793

WELL TESTING APPARATUS

Filed July 14, 1941

2 Sheets-Sheet 2



UNITED STATES PATENT OFFICE

2,363,793

WELL TESTING APPARATUS

Mont C. Johnson, Winterset, Iowa

Application July 14, 1941, Serial No. 402,387

7 Claims. (Cl. 166—19)

This invention relates to improved means used in connection with the determination of the depth of veins of water or any other liquid substance in the walls of an oil well, wherein the operator may easily, quickly and accurately determine the depth of an undesired vein of fluid within the well, even with the well filled with drilling fluid, wherein the operator may quickly and accurately determine the depth to form a casing to block out an undesired vein of fluid such as water, without blocking out the productive supply.

The object of my invention is to provide, for the purpose above stated, a device in the nature of an upright receptacle, or receptacles, which may be lowered into an oil well in connection with a suitable measuring cable for receiving an actual sample of a fluid in the wall structure of a well at the pre-determined depth, wherein the receptacle may be elevated to the surface and the nature and properties of the fluid therein determined, and in connection with said receptacle, means for sealing off a portion of the wall surface to prevent mixing with the fluid being extracted from the wall, any foreign fluid such as drilling fluids.

It is also desirable to determine the depth or thickness of the productive supply.

A further object of my invention is to provide means for obtaining fluids from the wall of the well and from the strata at a pre-determined depth, without being intermingled with foreign fluids, said means being adapted to be lowered into the well by means of a suitable measuring cable or other flexible supporting device which may be rapidly operated, without the necessity of coupling onto the test device heavy pipes or drill rods as heretofore has been the practice in obtaining such tests, thereby enacting a great saving of time and expense in taking said tests.

A further object of my invention is to provide an improved receptacle for obtaining samples of fluids from the walled structure of deep wells having an inlet opening and a valve for closing said opening, improved means for sealing a portion of the wall surface and communicating the same with said opening, for the purpose of excluding drilling fluids, and in connection therewith improved means for actuating the valve by an operator on the ground surface and for controlling the sealing means with the receptacle in a deep well.

My invention consists in the construction, arrangement and combination of the various parts of the device, whereby the objects contemplated are attained, as hereinafter more fully set forth,

pointed out in my claims, and illustrated in the accompanying drawings, in which:

Figure 1 is a diagrammatical sectional view of a deep well, illustrating the manner in which my improved method is carried out and the manner in which the mechanism for accomplishing the same is installed therein;

Figure 2 is a side elevation of my improved unit employing a number of superimposed receptacles for obtaining in one operation a number of tests from the walls of a well at a number of predetermined depths, a portion of some of the receptacles being partially shown in section;

Figure 3 is an enlarged detail sectional view taken on the line 3—3 of Figure 4;

Figure 4 shows the upper end of a receptacle with one side broken away and the head in center section;

Figure 5 is an enlarged detail sectional view taken on the line 5—5 of Figure 2;

Figure 6 illustrates a modified form with the upper receptacle in section and an adjoining lower receptacle partially in section, on the line 6—6 of Figure 7;

Figure 7 is a detail sectional view taken on the line 7—7 of Figure 6;

Figure 8 is a diagrammatical view illustrating the manner in which the modified form of my device is placed in a well;

Figure 9 is a diagrammatical view of the electrical circuit employed in the operation of my modified form;

Figure 10 illustrates the switch used in connection with said electric circuit; and

Figure 11 is a diagrammatical view of the electric circuit used in connection with my preferred form of the device.

My improved method consists in lowering into a deep well a tight receptacle having inlet and outlet openings and an automatically operated valve in the outlet opening to permit the escape of confined air in said receptacle when under pressure, and to prevent the entrance of any fluid through said opening, and a manually controlled, mechanically operated valve in the inlet opening, together with means for causing the inlet opening to be sealed to a portion of the wall surface at a predetermined depth, to exclude the entrance of drilling fluids, lowering the receptacle into the well by a flexible member, such as a measuring cable, to a predetermined depth, sealing the inlet opening over a portion of the wall of the well, then actuating the valve of said inlet opening to open the same, permitting fluids from the sealed portion of the well to enter said receptacle by the

inherent pressure of said fluid and then closing the said inlet valve after the receptacle has been filled with said fluid, and elevating the receptacle to the surface, determining the properties of the fluid extracted from said well, and, if necessary, recording the depth at which said fluid was drawn, and repeating said operation at various depths if the desired fluid was not obtained on the first test, until the sample of the desired fluid has been obtained, thereby enabling the operator to accurately determine the depth to form a suitable casing for blocking out undesirable fluid such as water. The above method is used in connection with obtaining samples wherein the inert pressure of the fluids obtained is sufficient to provide a sufficient flow of the fluid through the wall structure, to the receptacle, to obtain rapidly the desired sample. However, when the said inherent pressure is low, my invention also contemplates the idea of evacuating the receptacle of air pressure either after or before lowering the receptacle into operative position, wherein atmospheric pressure may be added to that of the fluid, causing the fluid to flow through the strata.

In the accompanying drawings I have illustrated one form of apparatus which might be employed in carrying out my preferred method, as illustrated in Figs. 1 to 5, inclusive, and in Figs. 6 to 10, inclusive, an apparatus for carrying out the modified method wherein the receptacle is partially evacuated after it has been lowered into operative position.

In Fig. 2 I have illustrated a unit formed of a series of superimposed receptacles 10 and an intermediate receptacle 11 forming a motor casing, each of said receptacles comprising an upright cylindrical wall 12 and a bottom 13, the upper end of the wall 12 having an inwardly extending flange 14, the receptacles being adapted to be stacked one on top of the other, as illustrated, with a suitable gasket 15 between them, said receptacles being bound together in a unitary unit by means of vertical rods 16 with nuts 17 on their upper ends. A chunk of lead 18 is secured to the lower end of the unit for causing the same to overcome the buoyancy of the hollow receptacles to permit the unit to be lowered into the drilling fluid. Each of the receptacles 10 is provided near its upper end with a valve casing 19 having an opening 20, which I shall term the inlet opening. Supported in said opening 20 is a nipple 21 formed preferably of elastic material such as rubber, and extending laterally from the side wall 10 a slight distance. A spring 22 is fixed to the outer surface of the wall 12 for the purpose of protecting the outer end of the nipple 21 as the receptacle is lowered to position in the manner hereinafter described.

The casing 19 includes a sleeve 23 having diametrically opposite slots 24 in connection with the interior of the casing 19. Rotatably mounted in the sleeve 23 is a valve 25, also having diametrically opposite slots or ports for communicating with the slots 24 when the valve is in one position of its movement, thus providing a rotary valve which may be easily operated even with the receptacle lowered into fluids of great depths, wherein the pressure may be two or three thousand pounds per square inch.

For actuating the valve 25 I have provided on its lower end an arm 26 pivotally connected to one end of the link 27, said link 27 being preferably of non-magnetic material and connected to one end of an iron core 28 of an electro magnet 29. A spring 30 is provided for moving the core

28 outwardly from said electromagnet and for automatically moving the valve 25 to a closed position. Thus means is provided whereby the valve 25 may be moved to an open position by simply energizing the electromagnet 29 through a suitable electric conductor 31 and a suitable switch device 32 supported on top of the ground surface, and by means of a supply of electrical energy 33, such as a storage battery or from a suitable power line, each electromagnet 29 having an individual conductor 31 and a common return 34, each of said conductors 31 having a switch 35 for connecting said conductor to the common return 34.

For causing the outer end of the nipple 21 to firmly engage a portion of the inner surface of the wall 36 I have provided adjacent to one side of the unit an upright pressure plate 37, mounted on a rack bar 38 at its central portion and slidably mounted in a suitable bearing 39 in the casing 11, the gear teeth 40 of the rack bar 38 being adapted to mesh with a pinion 41 mounted on the lower end of a motor shaft 42 carried by an electric motor 43 mounted in said casing 11, the said motor 43 being of the reversible type and provided with conductors 44 and 45 and a reversing switch 46 connected with said common return 34, wherein the shaft 42 may be rotated in either direction at the will of the operator, the rack 38 being moved outwardly when said motor shaft is rotated in one direction to cause the plate 37 to engage one side of the wall 36, and when so engaged, to move the casing 11 and the unit carried thereby, towards the opposite side of said wall, which in turn will cause the outer ends of the nipples 21 to be forced into sealing contact with said wall in such a manner that any drilling fluids within the well and surrounding the said casing will not be permitted to enter the opening when the valve 25 is moved to open position. One edge of the rack 38 is provided with ratchet teeth 47 adapted to be engaged by a pawl 48 carried by the casing 11, said pawl being yieldably retained in a closed position by means of an extensible spring 49 having one end connected to the inner end of a core 50 which is pivotally connected to said pawl and operatively mounted within the electromagnet 51 wherein the bar 38 may be automatically locked in position when the plate 37 is moved outwardly, after which the actuating current in the motor 43 may be shut off to prevent burning out the armature.

When it is desired to release the plate 37 from the wall 36 the electromagnet 51 is energized by means of a conductor 52 and a switch device 53 making connection with the common return 34, after which the switch 46 is operated to reverse the motor shaft 42, causing the bar 38 to be moved inwardly.

The upper end of each of the casings 10 is provided with a check valve 54 to permit entrapped air in the casing to escape as the test fluid flows therein and as the receptacle is elevated from a high pressure condition at the bottom of the well to a lower pressure condition near its top. The bottom of each of the casings 10 is provided with a plug 55 to permit the fluid to be removed from each of the receptacles independently and at the will of the operator.

In the practical operation of the device the upper end of the unit is connected to a measuring cable 56 which is passed over a pulley 57 and directed to a measuring device 58 which is of ordinary construction.

The electric conductors 31 and 34 and 52 are enclosed in a suitable cable 59 and wound on a suitable drum 60, each of the conductors 31 of said cable being operatively connected with the electric source by means of slip rings or other connection devices not illustrated, and which form no part of the present invention.

The buoyancy of the unit is such that an ordinary measuring cable is sufficient to carry the weight of the unit.

In practical operation of the preferred form of my device the valves 25 are normally closed by the spring 30 under normal atmospheric pressure. The unit is then lowered into the well to a depth determined by the measuring device 53 where it is thought that the undesired vein of fluid might be. The switch 46 is then closed, causing the motor shaft 42 to be operated to move the plate 37 outwardly until it engages the wall surface, after which the unit of receptacles is then moved in the opposite direction, causing the nipples 21 to be sealed against adjacent wall portions. One of the switches 35 will then be closed, causing the corresponding valve 25 to be moved to open position, after which fluid from the corresponding strata will flow into said receptacle, the entrapped air escaping through the check valve 54. After sufficient time has elapsed for the receptacle to fill, the switch 35 is opened, permitting the valve 25 to be closed by the spring 30. This operation may be repeated for each of the other receptacles 10 until all of them have been filled, after which time the pawl 48 is released by energizing the magnet 51, after which the motor shaft 42 is reversed, causing the plate 37 to move inwardly and the pressure against the nipples 21 released. The unit may then be elevated to the ground surface and the tests examined in the manner before described.

In the modified form illustrated in Figs. 6 to 10, inclusive, the unit is formed of a series of receptacles 10a similar to the receptacles 10 described in my preferred form, and a motor unit 11a in place of the motor unit 11, which is of the same construction, the main difference in the units 10 and 10a being that instead of the automatic check valve 54, a magnetically operated valve 61 is provided for closing a port 62 entering an evacuated tube 63, which tube may be cast into each of the casings 10a and 11a, the upper end of the tube 63 being provided with a flexible tube 64, the upper end of which leads to a vacuum pump 65 on the ground surface and operated by means of a suitable motor 66. Each of the valves 61 is mounted on a bell crank lever 67 yieldably moved to a closed position by means of a spring 68, a core 69 of an electromagnet 70 being provided for releasing the valve 61 when the said electromagnet is energized, each of the magnets 70 being provided with a conductor 71 leading to a switch device 72. By this arrangement, after the valve 25a has been opened, the valve 61 will also be opened permitting the chamber to be evacuated and additional active pressure applied to the fluid entering the inlet opening 20.

Thus, it will be seen I have provided an improved method and simple means for carrying out the method, wherein the operator may easily and quickly determine the actual depth of any undesired vein of fluid entering the well, the measurements being easily and quickly taken, requiring only a few minutes' time, whereas, in the methods now in common use it often requires a half day to obtain a single test, wherein it is necessary to lower the testing device by means

of ordinary drill rods which have to be coupled into position as the device is lowered.

I claim as my invention:

1. A device adapted to be lowered into a deep well by means of a measuring cable to obtain a sample of the fluid in the strata of the wall of the well at a predetermined depth, comprising a receptacle having an inlet opening in one side near its upper end, a yieldable nipple in said opening having one end projecting outwardly from said side and adapted to engage the adjoining side wall of said well, power actuated means for forcing said receptacle laterally to cause said nipple to engage said wall and to seal said opening against drilling fluids, a valve for said inlet opening, yieldable means maintaining said valve in a closed position, power actuated means for opening said valve, and remote controlled means for each of said power means controlling each of said power means independently.

2. A device adapted to be lowered into a deep well to obtain a sample of the fluid in the strata of the wall of the well, comprising a receptacle having an inlet opening in one side, a valve for said inlet opening, power means for opening and closing said valve, a yieldable nipple in said opening having one end projecting outwardly from said side, a pressure plate adjacent to the opposite side of said receptacle from said inlet opening, mounted to move toward and from said receptacle, and power means for actuating said plate to move it outwardly, whereby the plate will engage the adjacent side of a well and force the receptacle in the opposite direction, causing the outer end of said nipple to engage a portion of the wall of said well and seal said opening against drilling fluids entering the same, and remote means for controlling each of said power means independently.

3. A device adapted to be lowered into a deep well to obtain a sample of the fluid in the strata of the wall of the well, comprising a receptacle having an inlet opening in one side, a valve for said opening, power means for opening and closing said valve, a yieldable nipple in said opening having one end projecting outwardly from said side, a pressure plate adjacent to the opposite side of said receptacle from said inlet opening, mounted to move toward and from said receptacle, power means for actuating said plate to move it outwardly, whereby the plate will engage the adjacent side of a well and force the receptacle in the opposite direction, causing the outer end of said nipple to engage a portion of the wall of said well and seal said opening against drilling fluids entering the same, means for locking said plate in its outer position of movement, power means for releasing said locking means, and remote means for controlling all of said power means independently.

4. In a device of the class described, a series of fluid receptacles and a motor casing bound together to form a unitary unit, means for supporting said unit and lowering it into a deep well, each receptacle having an inlet opening, a rotary valve for each of said inlet openings, each of said receptacles having means for sealing its corresponding inlet opening to the side of the wall of a well, remote power operated means for controlling and operating said rotary valve to open and closed positions, a pressure plate movably supported on the unit, a motor within said motor casing, means actuated by said motor for moving said plate toward and away from said re-

ceptacle, and remote means for controlling said motor whereby the pressure plate may be moved away from the unit and against the side of the wall of a well and all of said receptacles moved in the opposite direction to cause all of said sealing means to engage the adjacent wall surface.

5. In a device of the class described, a series of fluid receptacles and a motor casing bound together to form a unitary unit, a measuring cable for supporting said unit, and lowering it into a deep well, each receptacle having an inlet opening, a valve for each of said inlet openings, each of said receptacles having means for sealing its corresponding inlet opening to the side of the wall of a well, remote power operated means for controlling and operating said inlet opening valve to open and closed positions, a pressure plate movably supported on said unit, a motor within said motor casing, means actuated by said motor for moving said plate toward and away from said unit, and remote means for controlling said motor, said pressure plate on movement away from said unit, engaging the side of the wall of a well and moving said unit in the opposite direction to engage all of said sealing means with the adjacent wall surface.

6. A device adapted to be lowered into a deep well to obtain a sample of the fluid in the strata of the wall of the well, comprising a receptacle

having an inlet opening in one side near its upper end, a yieldable nipple in said inlet opening having one end projecting outwardly from said side, power actuated means for forcing said receptacle laterally to cause said nipple to engage said wall and to seal said inlet opening against entrance thereto of drilling fluids, a valve for said inlet opening, power actuated means for opening and closing said inlet opening valve, and remote controlled means for independently controlling each of said power means.

7. In a device adapted to be lowered into a deep well to obtain a sample of the fluid in the strata of the wall of the well comprising a receptacle having an outlet opening and an inlet opening, a check valve for closing said outlet opening against fluid entering said receptacle, a rotary valve for said inlet opening, a lever for actuating said rotary valve, an electric solenoid within said receptacle, a core for said solenoid, means operatively connecting said core to said lever, yieldable means for moving the core in one direction to close said rotary valve, and an electric circuit for energizing said solenoid to open said rotary valve against the pressure of said yieldable means, said circuit including a switch device above the ground surface for controlling the energization of said solenoid.

MONT C. JOHNSON.